

Life Cycle Assessment of Advanced Materials – The case study of graphene oxide in drinking water filters

Veronique Adam¹, Matteo Vezzali², Letizia Bocchi², Blanca Suarez-Merino¹

1. Introduction

The European Commission, in its Recommendation for the implementation of a framework for safe and sustainable by design (European Commission 2022), advises to use Life Cycle Assessment (LCA) to evaluate the environmental sustainability of chemicals and materials. LCA is a standardised methodology (ISO 2006a, 2006b) to assess the environmental impacts of a product lifecycle across various impact categories. However, its applicability to Advanced Materials (AdMa) can be challenging due to lack of data, pertaining to the novelty of these materials and the products in which they are embedded.

2. Case study

Graphene oxide (GO) is used in drinking water filters to enhance their functionality and enable the removal of molecular-level emerging contaminants such as PFAS, metal ions and antibiotics. This case study is investigated within the MACRAME project with a contribution analysis of the flows and unit processes of the filters production to various environmental impacts, including climate change, resource use and ecotoxicity.

The lifecycle inventory was built on exchanges of information with the filters producer, enabling the use of first-hand foreground data, but several data gaps still needed to be covered. The Lifecycle Impact Assessment shows the contributions of different flows and unit processes to environmental impacts; the need for a GO-specific characterisation factor is discussed. The potential implications of these results on the design of the industrial process and on the environment are discussed.

3. Outlook

The filter use and end-of-life will be investigated in continuation of this work to obtain a cradle-to-gate LCA, and the lifecycle impacts of these filters will be compared to the benchmark product (i.e. same filter without GO). This work contributes to the

¹ TEMAS Solutions GmbH, Laetteweg 5, 5212 Hausen AG, Switzerland; veronique@temasol.ch

² Medica SPA, Group Membranes and Filters, Via Degli Artigiani 7, 41036 Medolla, Italy

sustainability assessment of AdMa; it will be considered in the GO drinking filter production in the aim of making it as sustainable as possible.

4. References

European Commission (2022) Commission Recommendation of 8.12.2022 establishing a European framework for 'safe and sustainable by design' chemicals and materials. 7 pp.

ISO (2006a) ISO 14040: Environmental management – Life Cycle Assessment – Principles and framework. 20 pp.

ISO (2006b) ISO 14044: Environmental management – Life Cycle Assessment – Requirements and guidelines. 46 pp.